Visual Detection of IEDs

Improving Human Performance through Perceptual Learning

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Agenda

- Introduction.
- Background.
- Scope.
- Project Team.
- Approach.
  - Training to recognize the signal.
  - Training to recognize changes in the noise.
- Conclusion.

Background

- The focus of this research is to improve the probability of detection of IEDs using human vision.

- According to Atkinson (2007), General Meigs imperative to "Train the Force," has saved innumerable lives -- "soldiers who once spotted few roadside bombs in Iraq now detect more than half before detonation."

- Based on evidence from an analysis of the probability of detection of mines (Staszewski and Davison, 2000), we believe further improvement is possible, specifically, by applying principles of "perceptual learning."

  – "Perceptual leaning involves relatively long-lasting changes to an organism's perceptual system that improve its ability to respond to its environment" (Goldstone 1998).

The Soldier or Marine is the best sensor to detect threats (to include IEDs) on the battlefield – this work seeks to enhance the performance of this organic sensor.

Scope of Overall Effort

- Assess current state of visual detection training.
- Identify potential areas where perceptual learning techniques can potentially positively impact training outcomes. Four mechanisms of perceptual learning.
    - Attention weighting.
    - Imprinting.
    - Differentiation.
    - Unitization.
- Make recommendations on the incorporation of perceptual learning techniques into existing training cycles.
    - Define requirements for training aids (to include virtual).
    - Draft program of instruction.
- Provide recommendations for assessment of implemented programs.

Project Team

MOVES Team

- Dr. Michael McCauley.
- Dr. Anthony Ciaverelli.
- LTC Jon Alt, USA.
- MAJ Michael Stinchfield, USA.
- MAJ Jason Caldwell, USA.
- Mr. Michael Guerrero, MOVES Research Associate.

External Partners

- Dr. Steve Burnett, JIEDDO.
- Dr. Grayson Cuqlock-Knapp, ARL.
- Dr. Adrienne Raglin, ARL.
- Dr. John Merritt, ARL.

Approach

- Train to recognize the signal.
  - Requires training set of images of specific device types.
  - Leverages repeated exposures to the signal to improve recognition in more complex scenes used in assessment.
- Train to recognize changes in the noise.
  - Requires training set of images of the operating environment.
  - Leverages repeated exposures to the operating "normal" noise presented by the operating environment to improve recognition that a change has occurred.

Training the Signal

- Perceptual learning trainer (PLT), v0.13.
  - Uses still images of IEDs as training stimulus.
  - Trainer specifies replications, duration, and transformations through xml script.

- Assessment.
  - Uses still images or video to assess subjects ability to detect signal.
  - Captures hit, miss, false positive, and correct rejection.

Tools

- Assessment and training tools using still images.
  - Perceptual Learning Trainer.
  - Applied Anomaly Detection Tool (AADT), ARL/RDECOM.

Training the Noise

- Virtual Change Detection Trainer.
  - Uses 3D virtual environment replicating noise typically observed in a "normal" urban setting as training stimulus.
  - Trainer selects type and volume of clutter to include in training cases.

- Assessment.
  - Uses 3D virtual environment with changes from the training case to assess trainee's ability to detect changes.

Recognizing Change

Problem:

Train Soldiers and Marines to more effectively identify changes in their operating environment which may indicate an imminent threat such as improvised explosive devices.

Application:

Trainer for ground forces prior to deployment to Current Operating Environment (COE).

Background:

U.S. and coalition ground force units regularly and repeatedly conduct missions on the same terrain in support of Counterinsurgency (COIN) operations. Lessons learned and the latest Tactics, Techniques, and Procedures (TTPs) place emphasis on the importance of **pattern recognition** to counter the effectiveness of enemy IED operations. Training Soldiers and Marines to improve recognition of environmental changes will prevent friendly forces from entering the kill zones of IEDs and will save lives.

Implementation:

Virtual environment change recognition trainer.

Prototype Example

Conditioning

Testing

Goals

1. Positive transfer of training on IED detection task.
2. Reduction in time to develop expert scan patterns.
3. Software configurable to changing threat TTPs.

Conclusion

- Proto-type assessment and training tools (v0.1) developed.
  - Exploring the integration of eye tracking software.
  - Exploring the consolidation of tools into a single package.
- Pilot studies planned for late summer and early fall to assess efficacy of approach.
  - Institutional review board packet submitted.
- Leading data collection effort sponsored by JIEDDO in partnership with ARL at Lone Pine, CA, 26-28JUL10.
  - Collection of images and video of devices in the environment.